Norovirus Leads the Pack:
A Five-Year Look at Enteric Outbreaks in Indiana

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Of all outbreaks that the Indiana State Department of Health (ISDH) investigates, enteric (gastrointestinal) outbreaks are the most common. This article will summarize findings from enteric outbreak investigations conducted by the ISDH Epidemiology Resource Center (ERC) and Indiana's local health departments (LHD) from 2000 through September 15, 2004. This summary does not include foodborne complaints investigated by the ISDH Food Protection Program.

Transmission Routes

From 2000 through September 15, 2004, the ISDH ERC investigated 116 enteric outbreaks. In general, enteric outbreaks may be transmitted through contaminated food or beverages, contaminated water, person-to-person contact (particularly in institutional settings), and contaminated surfaces. Figure 1 illustrates the breakdown of transmission routes, either foodborne, person to person, or unknown (no clearly defined mode of transmission). Figure 2 depicts transmission route by season of occurrence.

Figure 1.

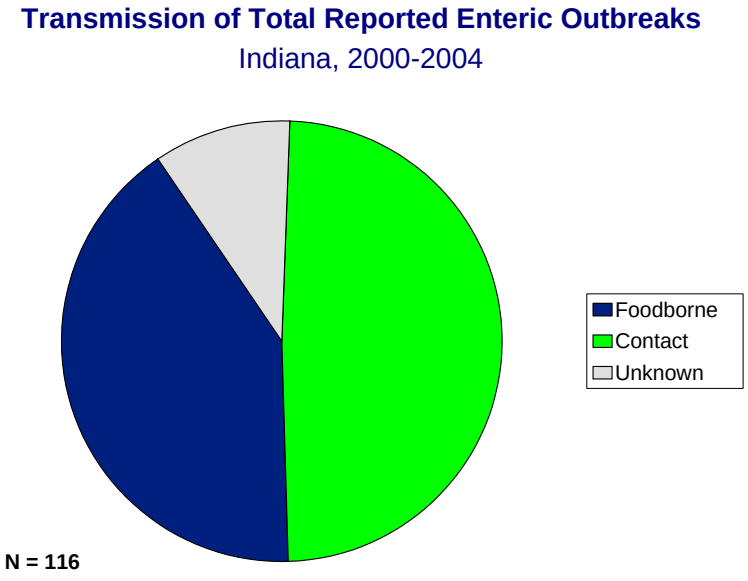
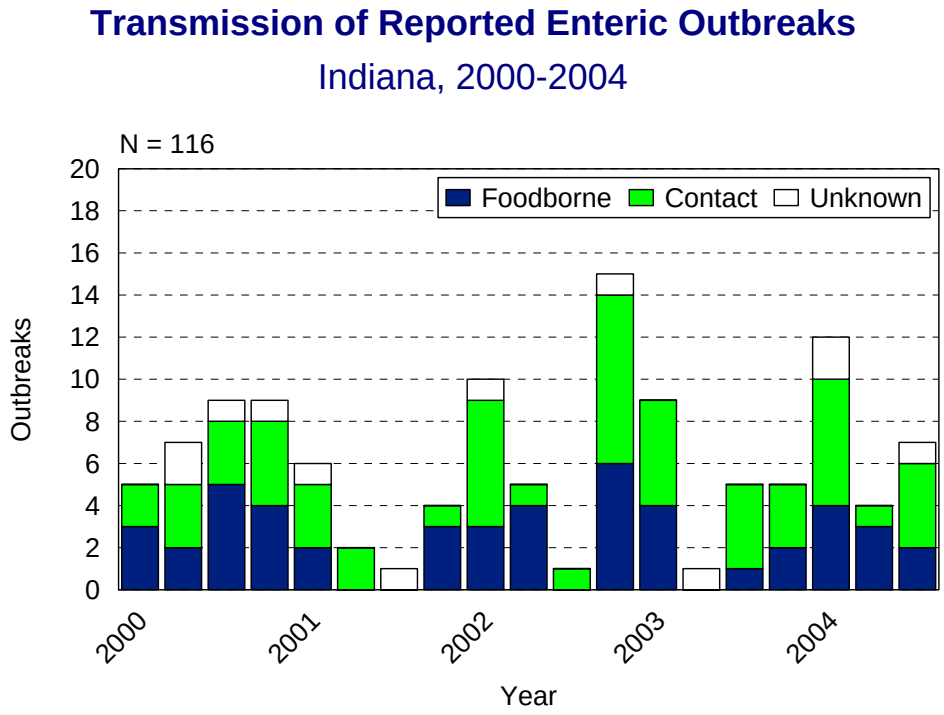


Figure 2.

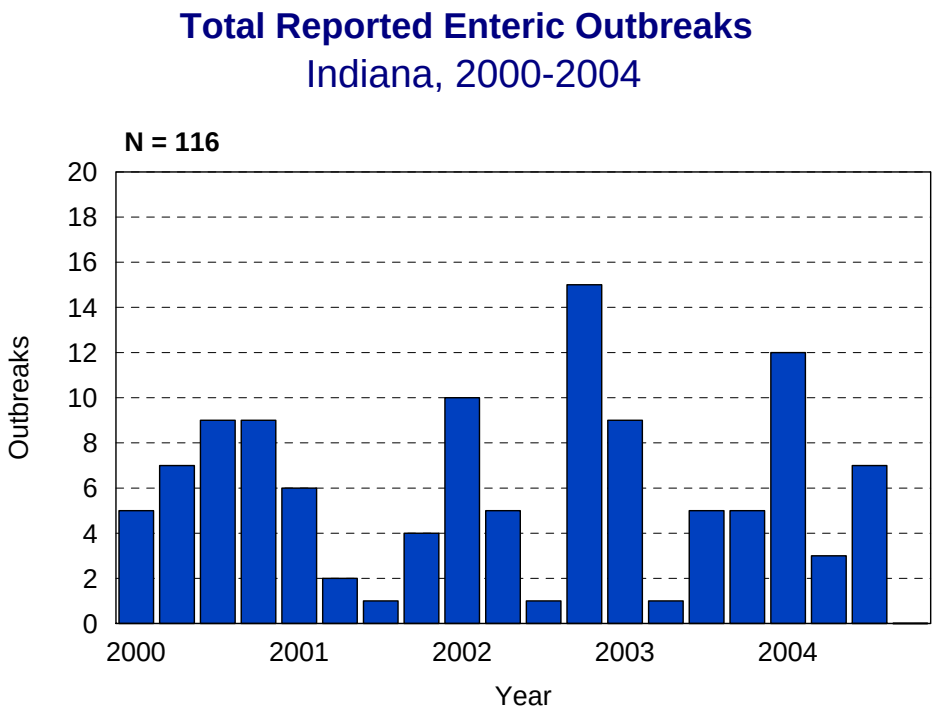


Agents of Illness

Contrary to the popular notion that enteric outbreaks peak during the summer, data show that, in general, enteric outbreaks in Indiana actually peak in the winter, following approximately the same seasonal pattern as influenza (see Figure 3). The reason for this becomes evident when examining the specific agents responsible for illness. Enteric outbreaks may be caused by a variety of agents:

- Bacteria (such as *Campylobacter, E. coli* O157:H7, *Salmonella, Shigella, Clostridium perfringens, Bacillus cereus*, and *Staphylococcus aureus*)
- Viruses (such as norovirus and hepatitis A)
- Parasites (such as *Cryptosporidium, Cyclospora*, and *Giardia*)
- Toxins (such as mushroom and seafood toxins)
- Chemicals (such as sanitizers, pesticides, and cleaning agents)
- Heavy metals (such as lead, arsenic, and copper)

Figure 3.



Agents are confirmed by laboratory testing of clinical and/or food samples. In the absence of laboratory testing, a specific agent may still be suspected on the basis of the clinical syndrome, incubation period, duration of symptoms, and possible exposure route or vehicle. Figures 4, 5, and 6 depict confirmed and suspected agents for all 116 enteric outbreaks investigated and by transmission route.

Figure 4.

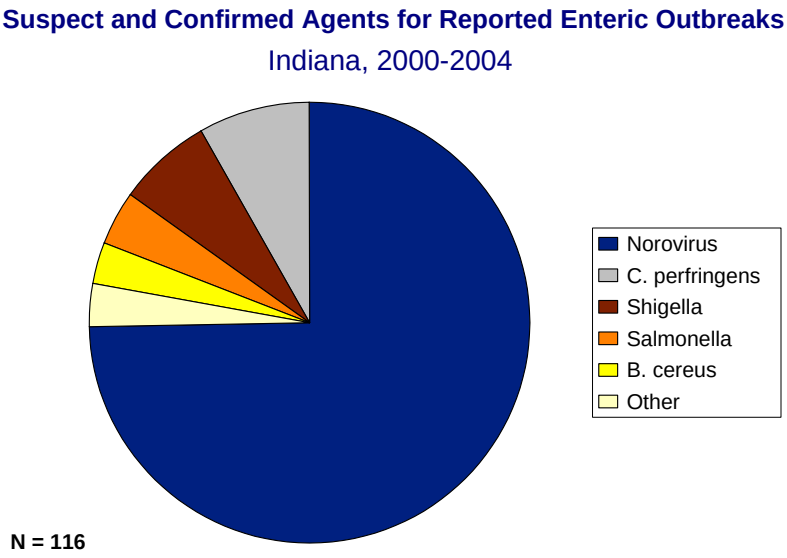


Figure 5.

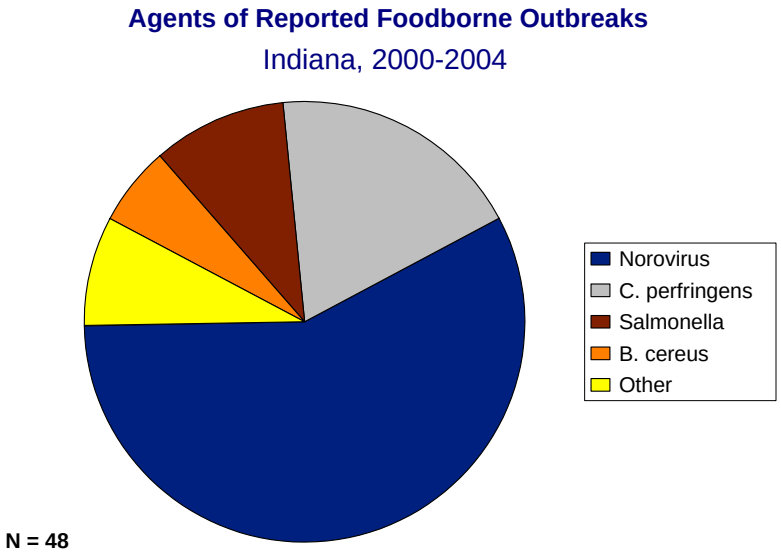
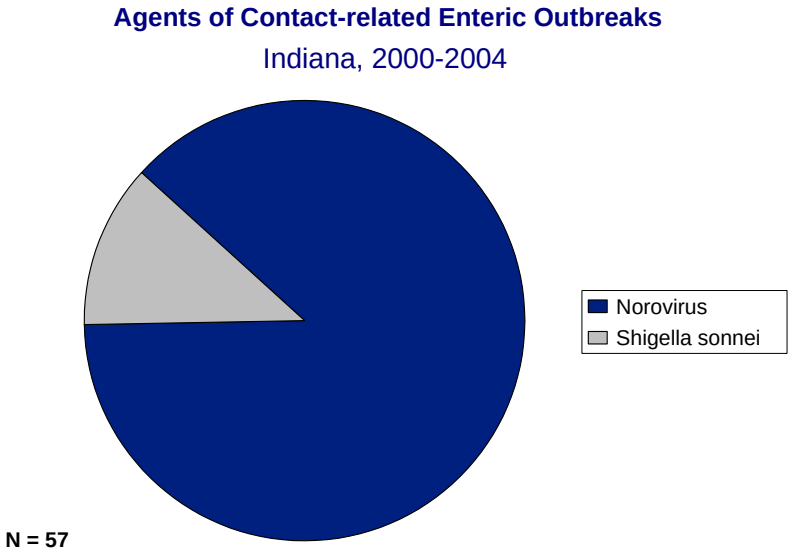


Figure 6.



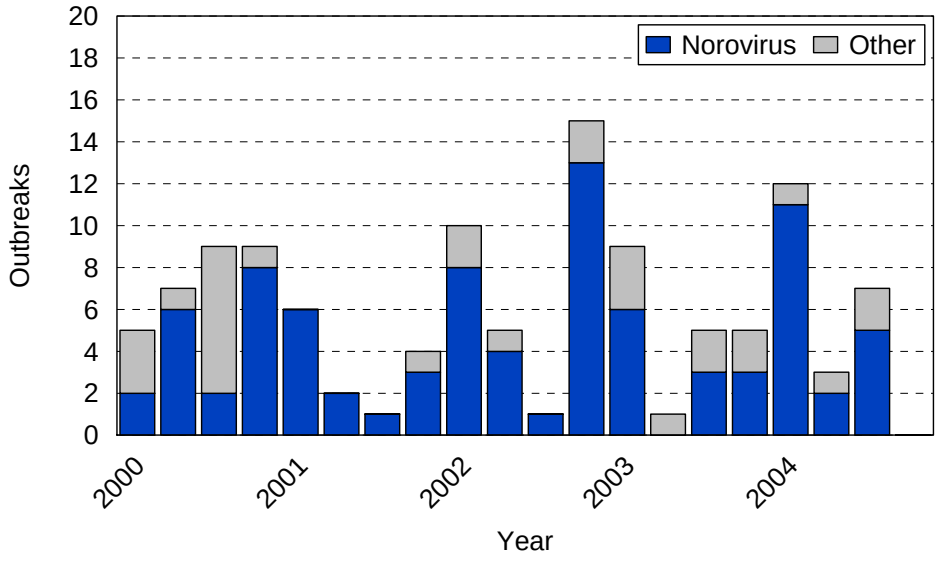
Impact of Norovirus

Figures 4, 5, and 6 also demonstrate the impact of noroviruses as causative agents of enteric outbreaks in Indiana. This impact is further illustrated in Figure 7, comparing the number of suspected and confirmed norovirus outbreaks against the total 116 enteric outbreaks investigated.

Figure 7.

Suspect and Confirmed Norovirus Reported Outbreaks

Indiana, 2000-2004



According to the Centers for Disease Control and Prevention (CDC), approximately 23 million cases of noroviral infection occur **each year** in the U.S., or about 1 out of every 12 people. The CDC also estimates that at least 50% of foodborne outbreaks nationwide are caused by noroviruses. As Figures 3 and 4 indicate, approximately 75% of total enteric outbreaks and approximately 60% of foodborne outbreaks from 2000-2004 in Indiana were related to noroviral infection. Although noroviral infection can occur at any time of year, the seasonal peak for infection occurs during the **late fall and winter months**. Figure 7 demonstrates the seasonality of norovirus infection and its impact on enteric outbreak occurrence in Indiana.

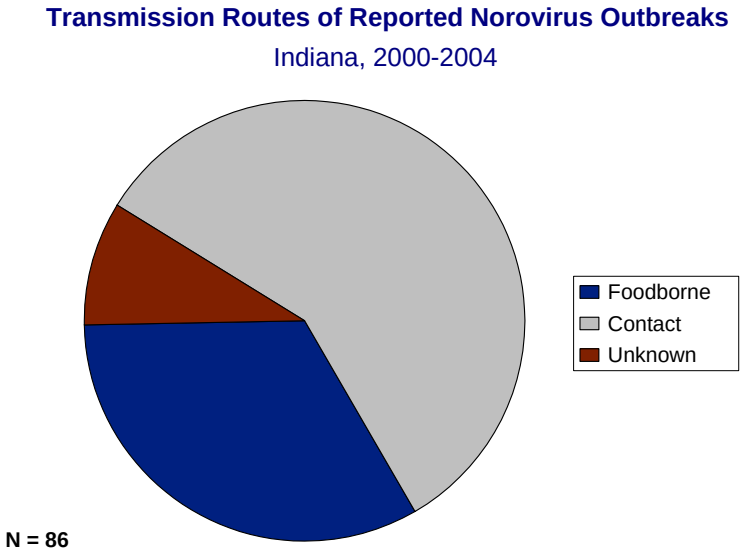
Noroviruses pose such a problem for several reasons. First, noroviruses are highly genetically variable, with new strains frequently emerging. For this reason, development of chemotherapeutic treatment or vaccines is unlikely, and none exists presently. The inoculum dose is extremely low (<100 viral particles). Research has shown that those infected with noroviruses can shed virus up to two weeks after symptoms stop, thereby serving as a reservoir to infect others in the absence of clinical illness. Immunity to noroviruses appears to be short-

term and dependent on age and overall health of the individual. Due to genetic variability, lack of cross-protective immunity to different strains, and lack of long-term immunity, people can become reinfected.

Environmental stability also contributes to the prevalence of noroviral infection. Noroviruses can remain viable on open surfaces, withstanding ambient temperatures and dryness that would adversely affect viability of other microorganisms. Noroviruses survive freezing, temperatures up to 140°F, and chlorine levels up to 10 ppm.

Noroviruses can be transmitted though a variety of routes, including contaminated food and beverages, contaminated water, person-to-person contact, and contaminated surfaces. Recent research has also indicated that noroviruses may be transmitted via droplets from aerosolized vomitus that have been swallowed. Figure 8 indicates transmission routes determined for suspected and confirmed norovirus outbreaks in Indiana.

Figure 8.



Food Vehicles

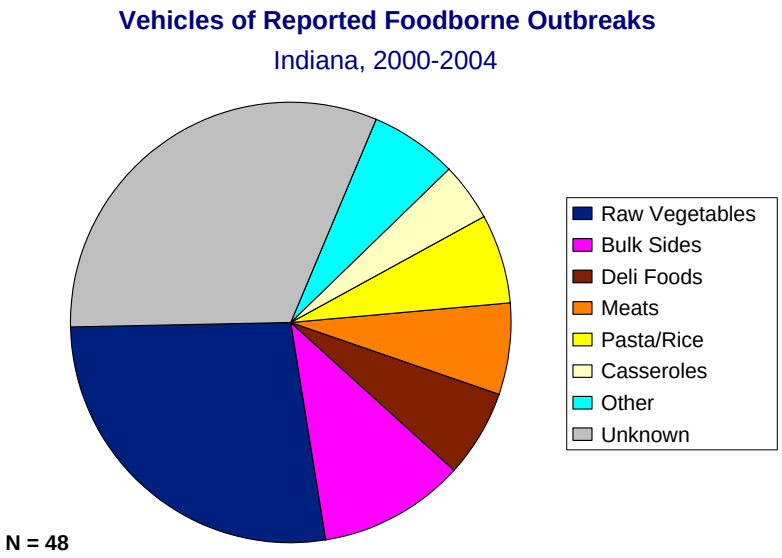
In foodborne outbreaks, it is important to identify which particular item(s) may be implicated in order to determine contributing factors and the most effective prevention measures. The most common food vehicles identified in foodborne outbreaks investigated during 2000-2004 are listed below, in order of prevalence:

- Raw vegetables (including lettuce, salad, and salsa)
- Bulk side dishes (including refried beans, stuffing, and mashed potatoes)
- Deli foods (including cold cuts and non-lettuce salads)
- Cooked meats

- Pasta/Rice
- Casseroles (meat or vegetable)
- Other
- Unknown

Figure 9 reflects the occurrence of these items as vehicles for foodborne illness outbreaks from 2000-2004.

Figure 9.

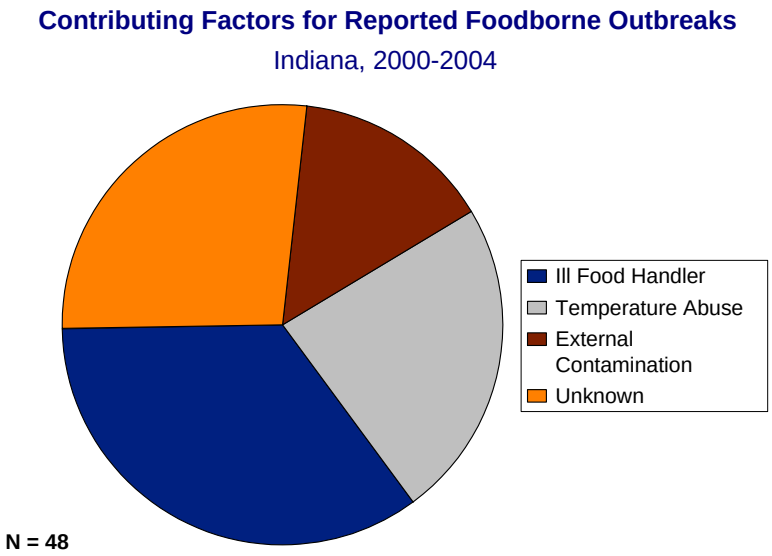


Contributing factors to food contamination included:

- Ill food handlers
- Temperature abuse (such as undercooking, improper thawing, slow cooling, and inadequate reheating)
- External contamination (including cross-contamination and contaminated surfaces)
- Unknown

Figure 10 indicates the occurrence of these factors identified in foodborne outbreaks from 2000-2004.

Figure 10.



Once contributing factors have been identified, the appropriate control and prevention measures can be implemented to stop the spread of illness. To prevent illness transmission among food handlers, thorough and frequent hand washing must be practiced after using the restroom and cleaning soiled areas. Food handlers ill with diarrhea or vomiting should be excluded from work. Requirements for exclusion and readmission to work can be found in the Communicable Disease Reporting Rule for Physicians, Hospitals and Laboratories (410 IAC 1-2.3) and the Retail Food Establishment Sanitation Requirements (410 IAC 7-24). Bare-hand contact with food should be eliminated as much as possible by using utensils or automatic dispensers.

Temperature abuse situations can be avoided by maintaining proper temperatures at critical control points during preparation. These may be found in 410 IAC 7-24. Calibrated thermometers should be used to verify correct temperatures, and commercial food establishments should document temperatures at these control points.

External contamination can be prevented by using separate equipment and preparation surfaces for meats and raw or ready-to-eat foods. Sanitizer levels should be maintained at the proper levels for adequate disinfection. For norovirus outbreaks, a 10% solution of household bleach should be used for soiled surface decontamination and food service items washed through a dishwasher cycle at the appropriate settings. 410 IAC 7-24 now requires all commercial food establishments to employ one person who is a certified food handler (after January 1, 2005). This will help ensure that establishment employees are aware of foodborne illness transmission routes and good food preparation practices.

Future Trends

Are there more enteric outbreaks now than in the past? Perhaps not. There is a greater awareness of foodborne illness, as evidenced by news reports of foodborne illness outbreaks and food recalls. Safe food preparation methods can be found on many food labels. Health hazards associated with eating undercooked foods are commonly included on restaurant menus. Greater awareness can lead to better reporting of outbreaks by the medical community and the general public. Improved laboratory testing, such as methods for detecting norovirus and genetic fingerprinting to identify related bacterial strains, can also help detect outbreaks that may have previously remained unidentified. Since July 2004, Indiana schools are legally required to notify LHDs of absenteeism rates of 20% or higher. This allows much more rapid identification of enteric (or any) outbreaks in schools that, again, may have previously been unidentified.

Are there more enteric outbreaks now than in the past? Perhaps there are. New agents and strains of existing agents, such as norovirus and *E. coli* O157:H7, are emerging. Antibiotic resistance is increasing with bacterial agents such as *Salmonella* and *Shigella*. The U.S. now relies on more food imports to maintain the public's taste for fresh fruits and vegetables year-round, as well as increasing appetites for more "exotic" foods. This allows for the possibility of agents previously unseen in the U.S., such as *Cyclospora*, or agents with low incidence, such as hepatitis A virus, to cause illness. Increased international travel also allows the importation of disease agents into the U.S. The recent increased trend for eating out allows greater potential for infected food handlers or breaches in food-handling practices to affect greater numbers of people.

Whether or not there are more enteric outbreaks now than in the past, all enteric outbreaks must be investigated promptly. The seemingly innocuous phone call received about someone becoming ill after eating at an establishment or event or attending a certain school or daycare may represent just the tip of the iceberg. To report an enteric outbreak, please contact the District Field Epidemiologist or Lee Bray, ISDH Enteric Epidemiologist, at 317-234-2808 as soon as possible.

References

Norovirus: Technical Fact Sheet. Centers for Disease Control and Prevention, January 2003. http://www.cdc.gov/ncidod/dvrd/revb/gastro/norovirus-factsheet.htm

Centers for Disease Control and Prevention. "Norwalk-like viruses:" public health consequences and outbreak management. MMWR 2001;50 (No. RR-9):[1-8].